

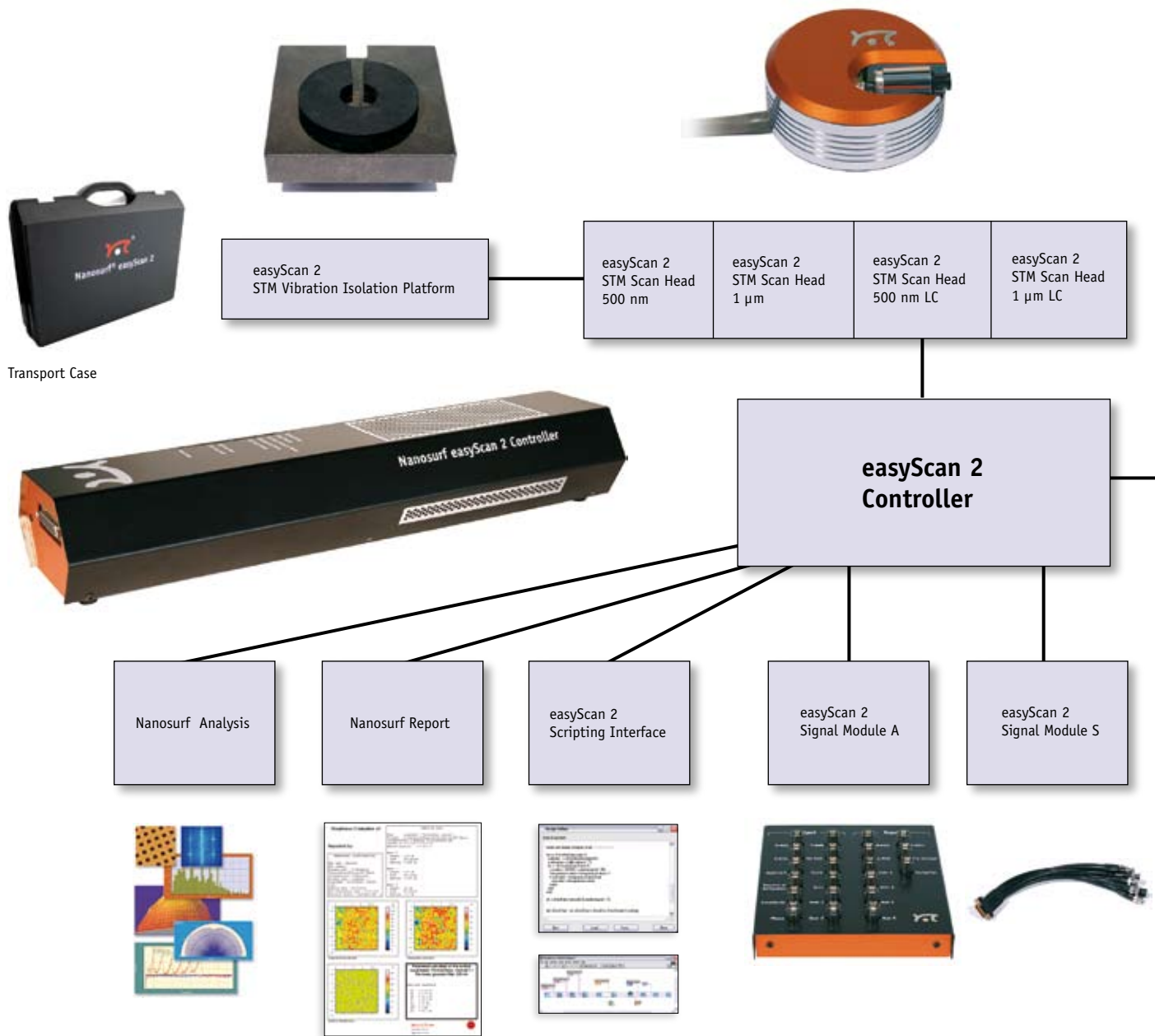
Nanosurf® easyScan 2

Scanning Probe Microscopes - Your Modular System



Perfect Modularity

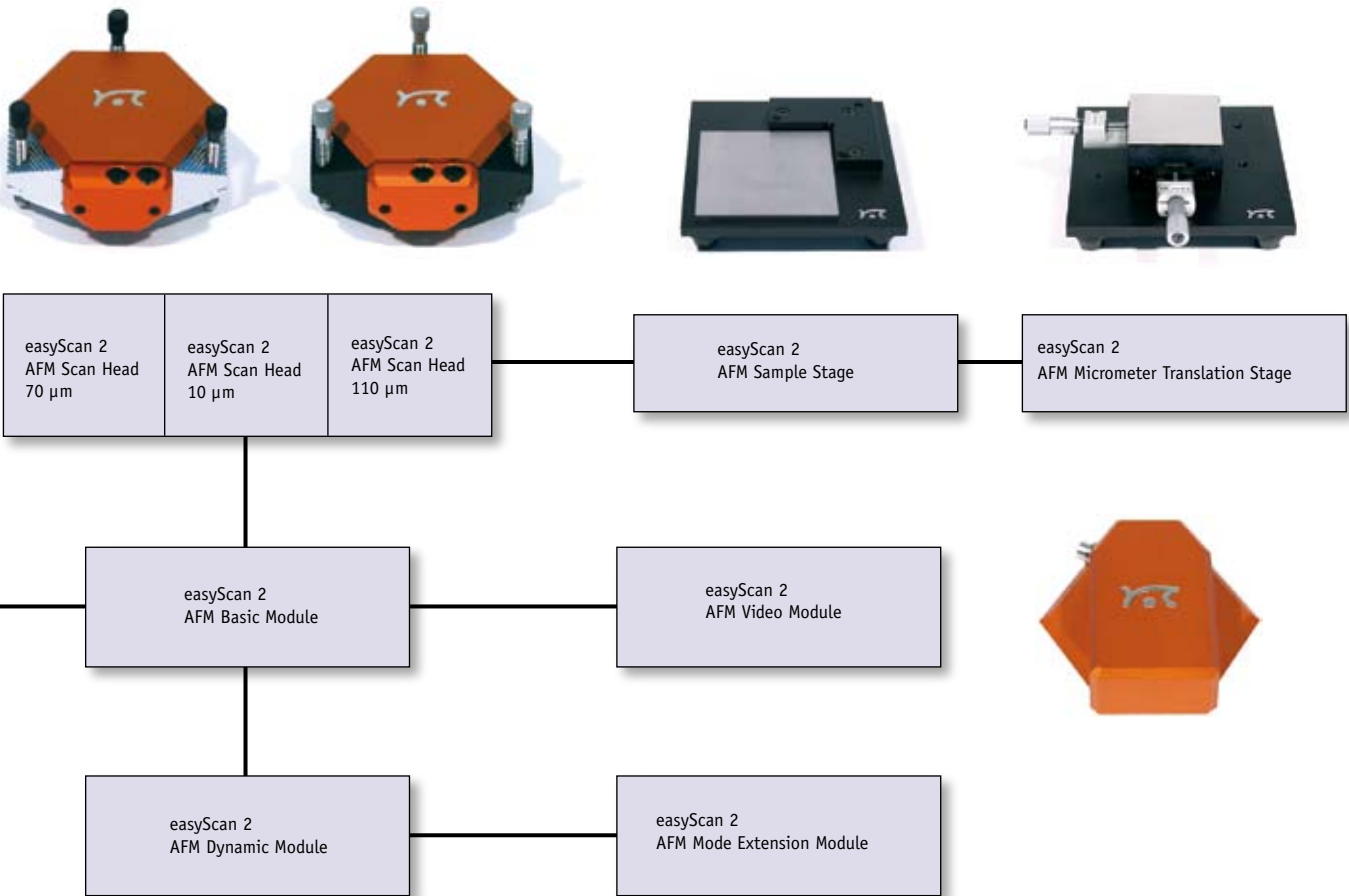
Nanosurf's easyScan series has gained worldwide popularity through its affordability, portability, and ease of use, with hundreds of systems currently in use. Now its successor, the easyScan 2, unites these three unique characteristics with a fully modular system design. Whether you need a teaching tool, a training Scanning Probe Microscope, or a research instrument, what you need is what you get.



The diagram above illustrates the major easyScan 2 components and modules in their possible combinations. The easyScan 2 Controller forms the backbone of the system. In its basic state it is able to control any easyScan STM Scan Head – it is up to you to choose which of the four STM Scan Heads best fits your needs. Adding the AFM Basic Module allows it to control any easyScan AFM Scan Head and to measure in Static Force mode. With the AFM Dynamic Module dynamic force measurements become possible. The AFM Mode Extension Module extends your system by including Phase Contrast, Force Modulation, Spreading Resistance, Magnetic Force and Electrostatic Force mode. The three AFM Scan Heads differ in scan range and resolution only, with the exterior colour scheme setting apart the general purpose 70 μm head from the more specialised 110 μm head (large scan) and the 10 μm head (high resolution). The latter in particular benefits from the addition of the Micrometer Translation Stage, which serves to position the sample precisely and reproducibly for spot measurements.

Key Features and Benefits

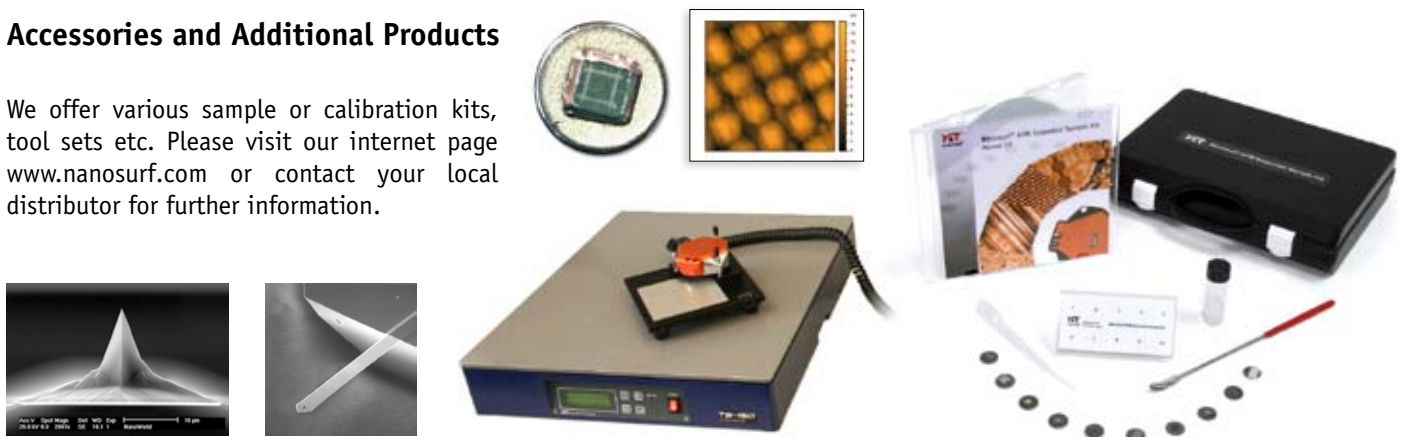
- Modular: Expandable to suit user needs
- Portable and compact: Transportable and easy to install with a small footprint
- Easy to use: Designed for quick and reliable measurements by experts and novices alike
- Affordable: Unique price/performance ratio for research and teaching
- Swiss made: Top quality ensures your satisfaction



With such complete modularity, the user alone decides where to begin. You can start exploring the details of your nanometric world with the STM and add an AFM later; or begin with a Basic AFM Package and add Dynamic Force capacities later; or first simply add a Signal Module to the STM – all of these possibilities and many more are yours with the easyScan 2. You can tailor your system to your needs and your resources and expand it later at will as needs and resources grow! The easyScan 2 is more affordable, portable, and easy to use than ever, making it an essential tool for teaching, training, developing and research in nanotechnology – browse through the following pages for a few concrete examples.

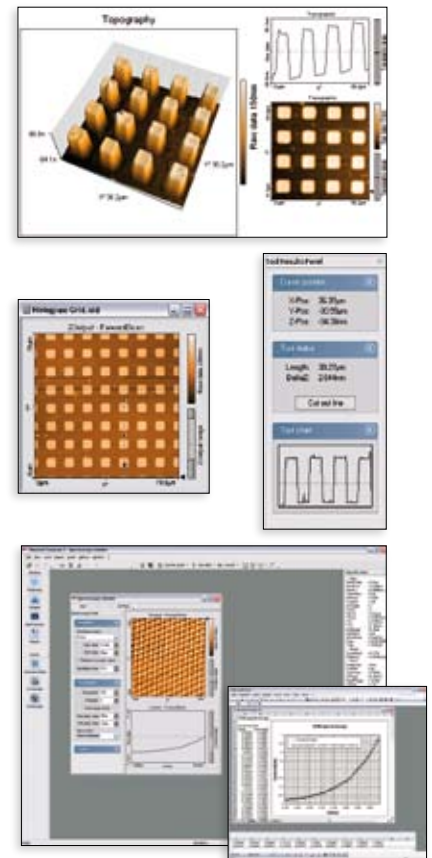
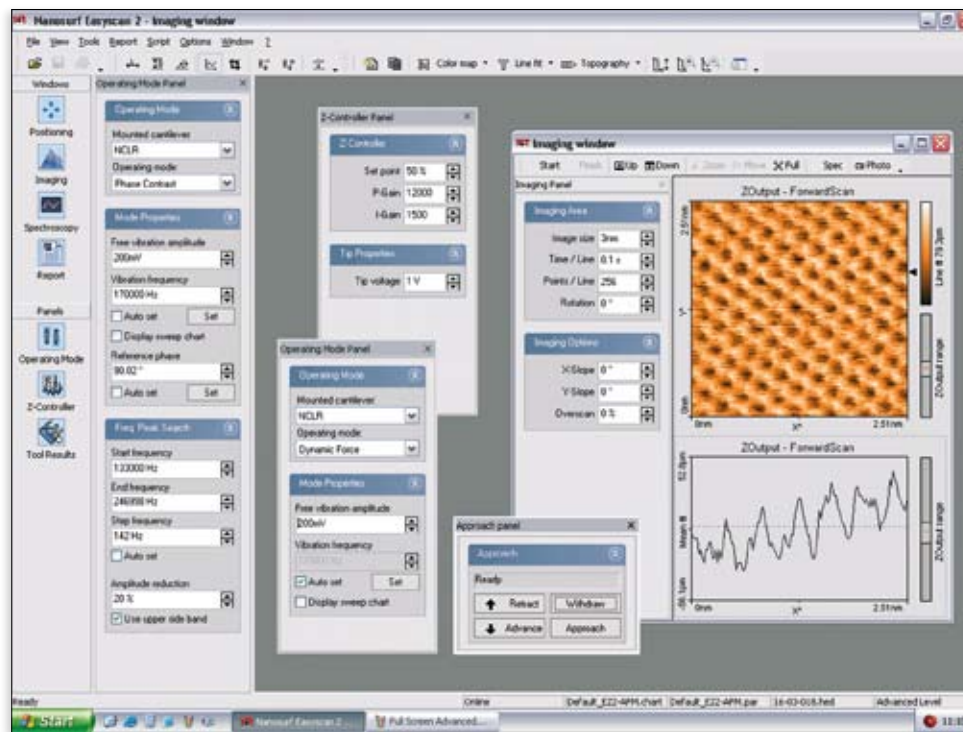
Accessories and Additional Products

We offer various sample or calibration kits, tool sets etc. Please visit our internet page www.nanosurf.com or contact your local distributor for further information.



Flexible easyScan 2 Software

The easyScan 2 software is a dedicated SPM software tailored to the modularity of the easyScan 2 system. It adapts itself to the system and scan head currently in use by automatically detecting the scan head type and changing the control options to reflect the system configuration. It also allows the user to set the level of interface complexity, from an easy level where the most important parameters can be set in a simple manner to an advanced level that offers detailed control but also requires a more comprehensive theoretical knowledge. This user interface level can be chosen independently of the scan head and can be changed at any time.



Spectroscopy windows and imported data to spreadsheet

- Clear and intuitive interface: Minimal instrument training time
- Automatic system recognition: Identical user interface independent of system configuration
- Three user interface levels: Easy, Standard, Advanced
- Real-time parameter adjustment and analysis: Fast results and full control
- Standard analysis tools integrated: background subtracting, filtering, section analysis, 3D images, height, distance, angle measurements
- Modular, adaptable to user needs through additional Software: easyScan 2 Scripting Interface, Nanosurf Report or Analysis

Real-time Performance

Whatever the system or the user interface, the easyScan 2 software reacts in real-time to user input. Even while measuring, the scan and acquisition parameters can be adjusted, the imaging window can be arranged to monitor all signals simultaneously, the image area, size, and online analysis can be adapted, and features of the current image can be analysed.

Powerful Software Components

To further enhance your system, simply add any of our three additional software modules: Nanosurf Report, Nanosurf Analysis and the easyScan 2 Scripting Interface. Joining these modules to the basic easyScan 2 software opens up your system to powerful measurement analyses as well as customised functions and automation.

Nanosurf Report – Image Processing and Reporting

Nanosurf Report enables mathematical image treatment and analysis, from filtering out of noise and waviness to generating 3D representations, volumetric measurements and standard roughness parameters of the inspected surface. Users with repetitive tasks at hand will benefit in particular from the automated report generating possibilities. Here, a template report can be applied to a whole array of similar measurements, ensuring quick, reliable and reproducible analysis. Nanosurf Report documents allow certification of quality control processes by keeping track of all operations applied to the images.

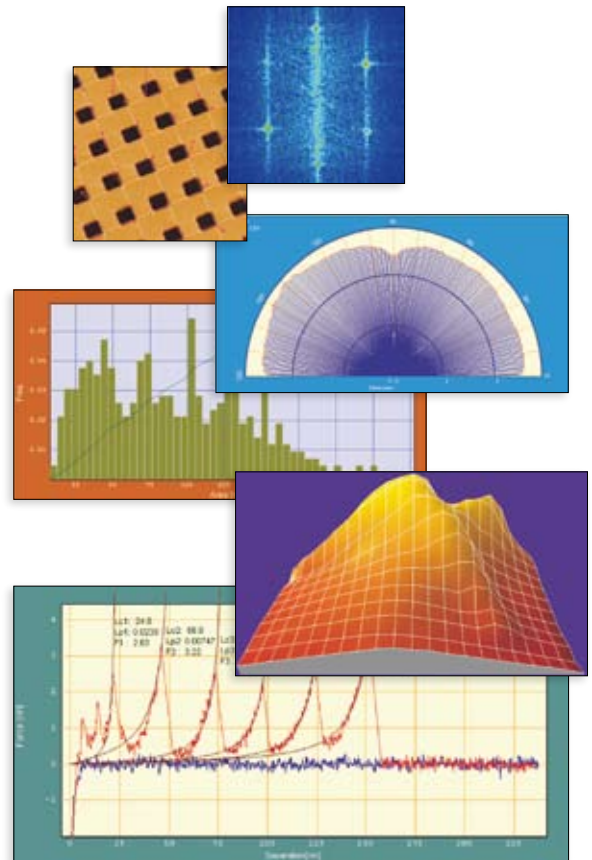
- Complete report creation: Creation of meaningful, visually appealing, professional reports - including measurement analysis, text commentaries, logos, time stamp and images
- Automated report generation: Efficient generation of standard reports with templates
- Able to read multiple file formats of other instrument manufacturers



Nanosurf Analysis – Image Analysis and Processing

Nanosurf Analysis enables advanced mathematical image treatment and analysis, from filtering, calibration, tip characterisation, extended Fourier analysis, grain analysis, force curve analysis, movie and time series analysis to generating photorealistic 3D representations of the inspected surface.

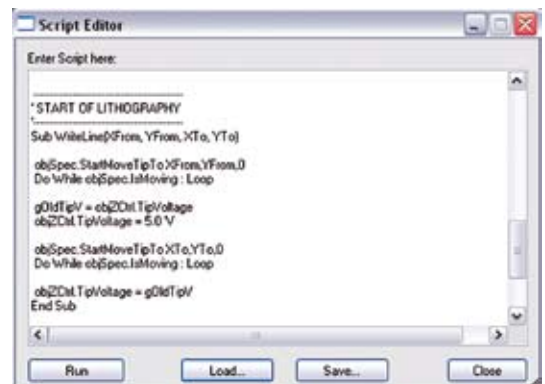
- Advanced measurement and analysis: Extract the information you need
- Noise reduction and feature enhancement: Visualise the true surface
- Extensive calibration and tip characterisation possibilities: Know your measuring equipment
- Able to read over 50 file formats of other instrument manufacturers



easyScan 2 Scripting Interface - Unlimited Freedom

The easyScan 2 Scripting Interface allows the user to control the instrument behaviour with user-defined Visual Basic scripts. Customise spectroscopy, z-controller, operating mode parameters, and user I/O; Create new documents and charts; add mathematical operations such as histograms, filters, and correlations; and exploit control functions for special applications. The Scripting Interface also allows coordination with external programs via Microsoft standard COM automation. In this way, even not so easy measurements can be performed with our distinctive easy to use software.

- Control over the measurement: Lithography, nano-manipulation, complex spectroscopy, automated measurements
- Expandable software through scripting: User-defined data analysis capabilities
- Built-in Visual Basic script editor: No external compilers needed
- COM Automation: Coordination with external programs (e.g. LabView)

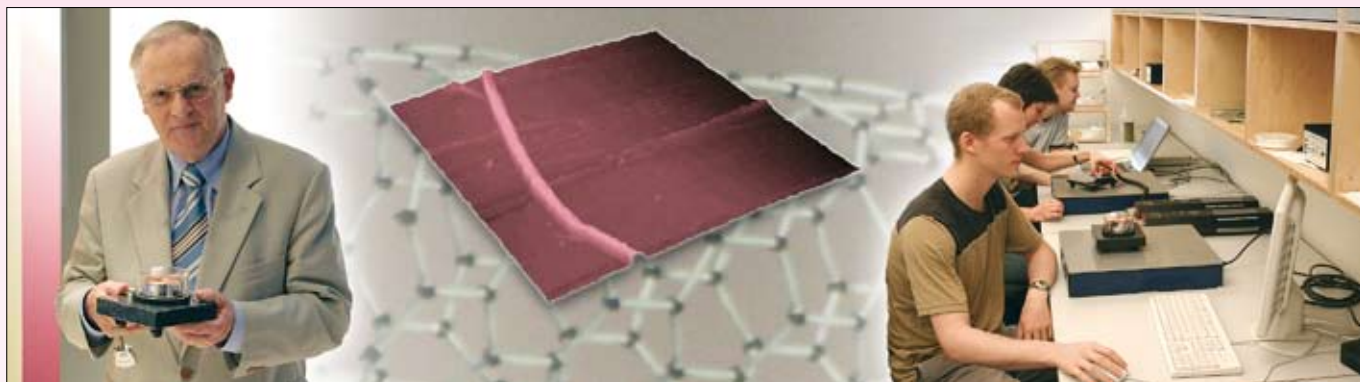


Basic STM Package

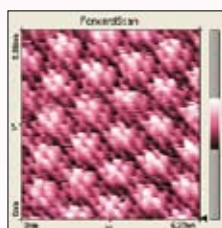
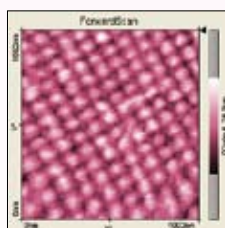
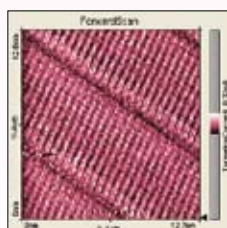
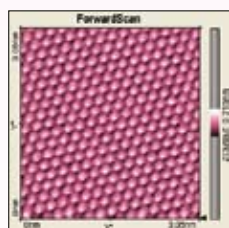


The first scanning tunneling microscope (STM) was developed by Gerd Binnig and Heinrich Rohrer from the IBM research laboratory in Rüschlikon, Switzerland, and first made atoms accessible to trained scientists. The easyScan 2 STM goes a step further and makes atoms accessible for everyone.

This is why, around the globe, hundreds of easyScan STMs form a crucial part of nanoeducation, whether in the framework of physics, chemistry, or materials science. Teachers appreciate the easy and hassle-free classroom demonstrations they can offer, and students find themselves motivated by the rapid success of their first step into practical nanoscience, be it in a lab assignment or a research project, in high school or graduate studies. Tips for the STM are simply cut from a Pt/Ir wire without any etching in hazardous substances, and the easyScan system's low voltage further ensures the operator's safety.

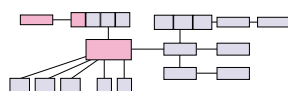
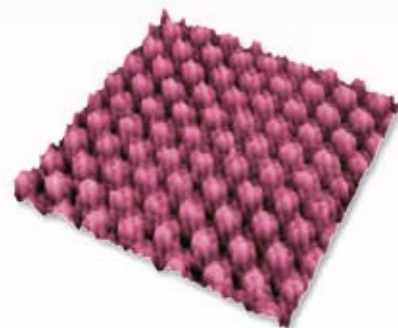


The easyScan STM has also established itself as a full-fledged research and development tool. Applications range from routine process control such as spot-checking nanocircuitry to fundamental research such as single electron spin detection and spectroscopy. Now, with the easyScan 2 series and its Signal Module, scientists can expand the possibilities of their easyScan STM even further. And, thanks to its ease of use, those who want to use their STM for student labs can, without fearing damage to their research equipment.



- Atomic lattice image of graphite
- Dotriacontan thin film (organic layer) (by Dr. J. Francis Wolf, HU-Berlin, Germany)
- NanoGrid
- Charge density waves on TaS₂

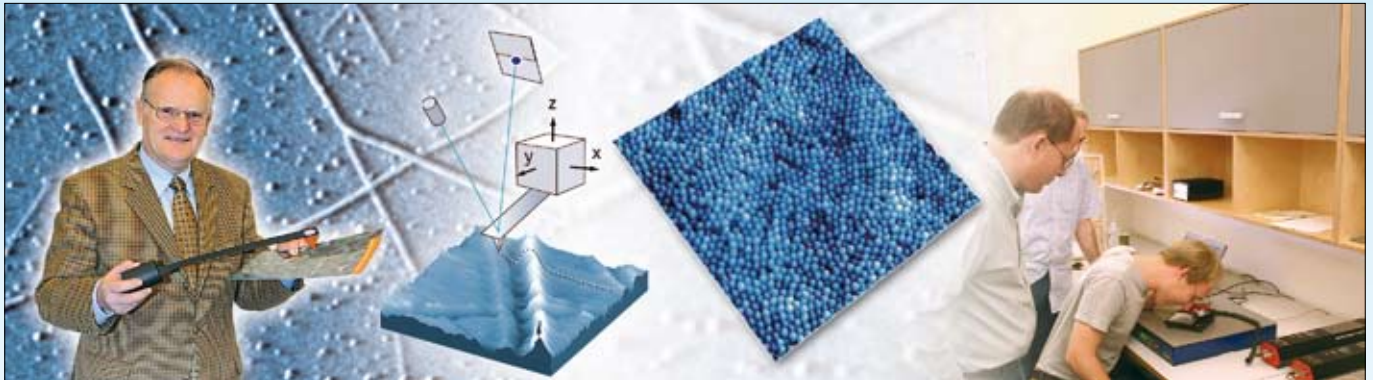
- Easy to use: Ideal for nanotechnology education and outreach
- Quick atomic resolution on a normal table: No need for expensive vibration isolation
- Portable and compact: Transportable, easy to install with a small footprint
- Accessible sample stage and scanning tip: Quick exchange of tip and sample
- Low operating voltage: Safe for all users



Basic AFM Package

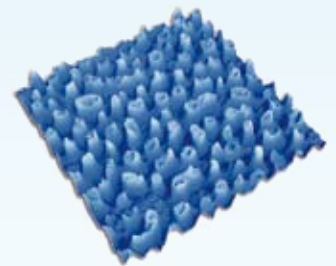


The easyScan 2 Basic AFM Package masters topography imaging, force spectroscopy and lithography in Static Force mode – the fundamental functions for surface measurement and modification. Along with its easy handling and positioning and its capability of measuring on nearly any sample size and geometry, these features make this the ideal package for use in all entry level situations. Give students an easyScan 2 Basic AFM Package, and they will learn about surface roughness, interatomic forces, hardness, and feedback loops. Give teachers an easyScan 2 Basic AFM Package, and they will teach their class about ultra large scale integration, corrosion, surface tension, and the limitations of optics. Give a small or medium enterprise an easyScan 2 Basic AFM Package, and they will have a tool to inspect their surfaces that can upgrade its measurement capabilities as their technology advances, a flexibility unique to the easyScan 2 system.

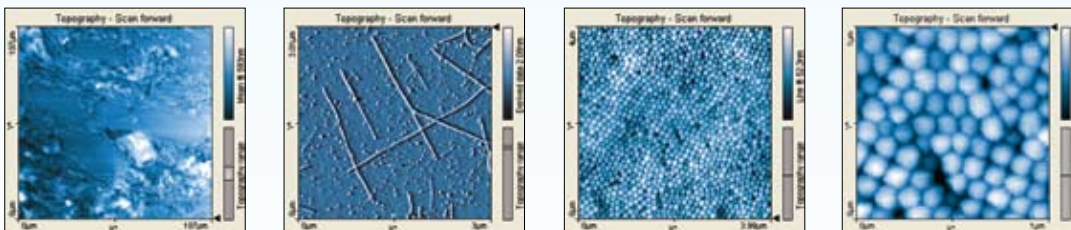


Smart Technology

Instead of piezoelectric materials that require high voltages and are vulnerable to creep, the easyScan 2 AFM uses a patented open-loop electromagnetic scanner that boasts an XY-Linearity Mean Error of less than 0.6% with low noise and low power consumption. This and similar smart design features allow a reduction in cost without a loss of precision performance. The Basic AFM Package makes professional high resolution surface measurements available to everyone.

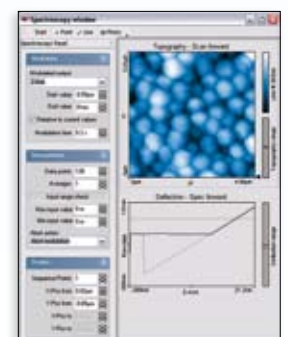


PS/PMMA film
scan size: 5µm - z-range: 10nm

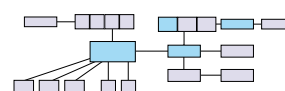


- Skin Cross Section
- Carbon Nanotubes
- Silica Beads
- Silica Beads, high resolution

- Portable, compact atomic force microscope: Fits in every lab
- Stand-alone design: Able to measure on small and large samples alike
- Easy to use, dual lens and automatic approach: Ideal for nanotechnology education and outreach
- Cantilever Alignment Chip technology: Easy tip change without laser adjustment
- World's least expensive commercial AFM



Spectroscopy window



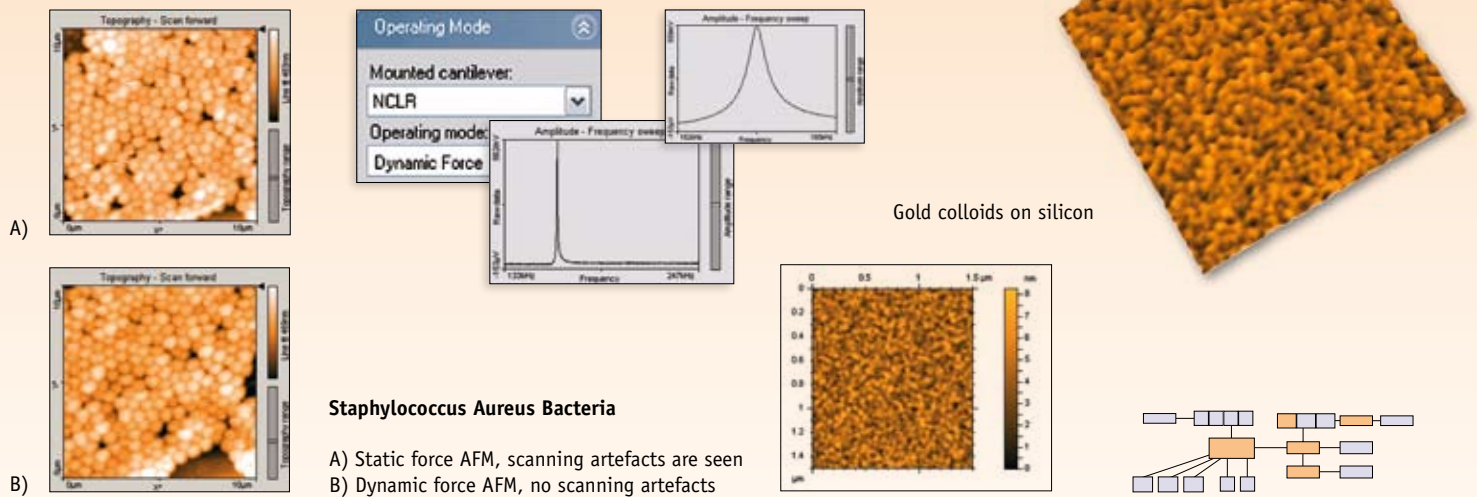
Basic Dynamic AFM Package



More often than not, the sample dictates the measurement mode. Soft, sensitive or sticky samples suffer under static force, even if the forces amount to less than 20 nN.

The Dynamic Force Module offers an ideal solution. Instead of tracing the topography line upon line with a constant force, the cantilever is vibrated near its resonance frequency and scanned across the surface with a constant vibration amplitude, thus experiencing only intermittent contact with the surface. In this manner, dynamic force microscopy eliminates potentially damaging lateral forces, making it the method of choice for many AFM measurements. The Basic Dynamic AFM Package is ideal for introducing students to the Dynamic Force mode.

- All the advantages of the Basic AFM
- Dynamic Force Module: Measure sensitive samples and loosely attached particles with ease
- Intermittent contact: Prevent measuring artefacts of surface capillary forces

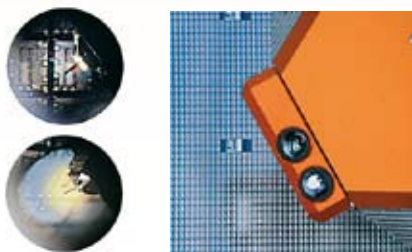


Simple Cantilever Replacement

Changing the cantilever takes three easy steps: cover the scanner with the DropStop, lift the cantilever holder, and replace the cantilever. When the cantilever holder is released and the DropStop removed, the Probe Status LED stops flashing and confirms the AFM is ready to measure.

Professional surface measurements require professional equipment. Starting with our Basic AFM Package we use only top quality cantilevers fitted with the alignment chip mounting system pioneered by NanoWorld.

Easy Positioning



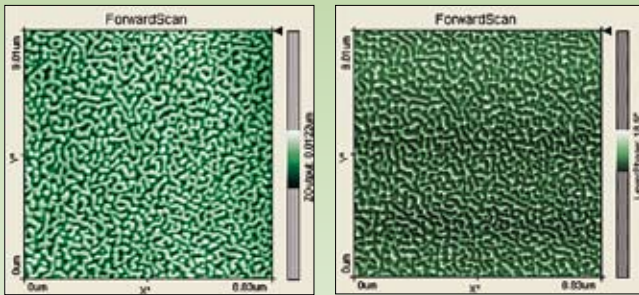
The two view lenses built into the easyScan 2 AFM offer a top view that shows where on the sample the cantilever is positioned and a side view that shows the probe-sample distance. Positioning the sample for measurement thus becomes simple and intuitive.



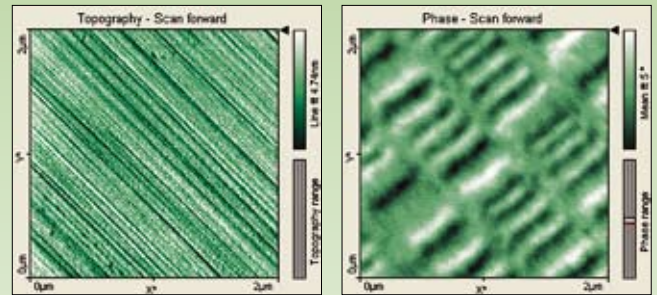
■ Multiple Mode Package



Users who want to measure more than topography will appreciate the Multiple Mode Package, which adds Phase Contrast, Force Modulation, Scanning Spreading Resistance, Magnetic Force and Electrostatic force modes to its standard Static and Dynamic Force capabilities. The easyScan 2 STM, also part of this package, provides the possibility of further analysis of conductive samples.



Thin layer of a blend of PS/PMMA film. Topography / phase contrast



Magnetic hard disk. Topography / magnetic bits

The Phase Contrast mode images the phase shift of the resonance frequency, which is influenced by changes in the mechanical or chemical properties of the sample surface, allowing simultaneous imaging of material contrast and sample topography. Magnetic Force Microscopy is an extension of the Phase Contrast mode, using a magnetically coated tip to detect local changes in sample magnetisation, and the Scanning Spreading Resistance mode uses an electrically conducting tip to map local resistivity. All these modes allow the detection of features not visible in pure topography measurements: “sticky” areas, data storage bits, and leakage current, to name a few examples.

To facilitate positioning, the Multiple Mode Package includes the Video Module, which shows the views through the two lenses directly on the computer screen. The video image, which can be switched between the two views, can be saved for further reference.

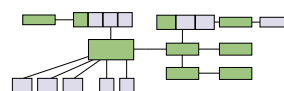
- AFM Mode Extension Module: Additional measuring modes and sample information
- Dual lens video camera: Inspect the cantilever position on your computer screen
- STM Scan Head: AFM complement for research and education



Dual lens video camera



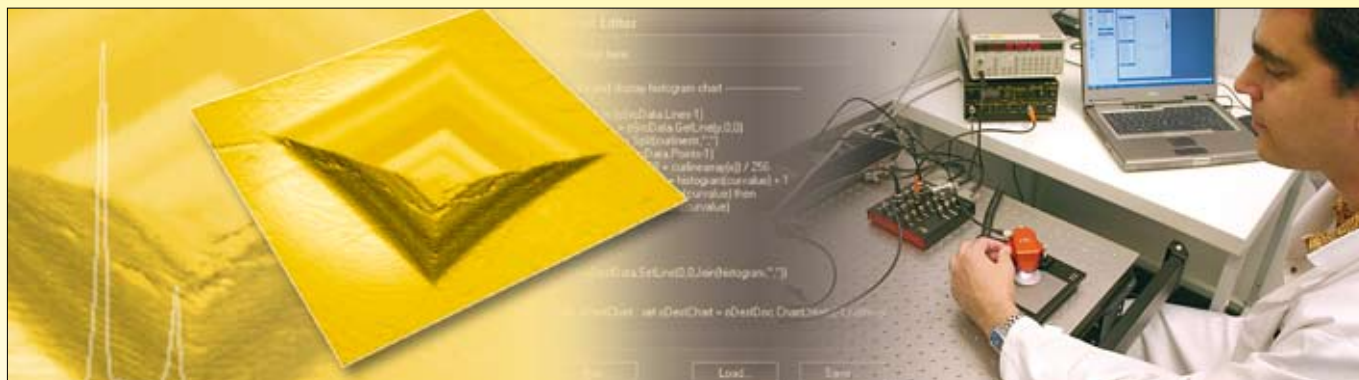
STM scan head



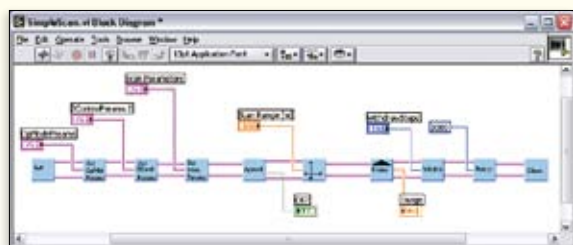
Advanced Research Package



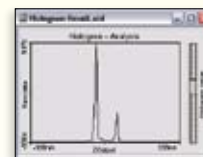
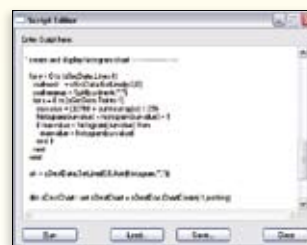
The Advanced Research Package goes a step further. Not only does it offer all the capabilities of the Multiple Mode Package, it also offers access to and control of all the relevant electronic signals and full COM automation with the Signal Module A and easyScan 2 Scripting Interface, resulting in a full-fledged research microscope with the typical Nanosurf ease of use. The user can modulate driving signals or the scanner position at will, opening up possibilities of lithography and experimental microscopy. All signals are accessed and modulated via standard BNC connections. The results can be analysed in depth and presented in professional standard reports.



While some customers with basic systems may already need a scan head other than the standard mid-range model, owners of the Advanced Research Package will benefit even more from the high resolution Scan Head or the large range Scan Head. The former allows measurements of atomic steps and minuscule features, while the latter allows the metrology of volumes of up to $200'000\mu\text{m}^3$. Switching between scan heads requires nothing more than loading the calibration file that corresponds to the head plugged into the controller. This is nano-exploration at its most versatile, the result of successively expanding the easyScan 2 system.

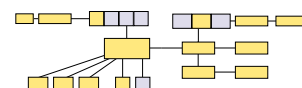


Scripting Interface examples: External instrument control with Lab View



Histogram analysis with built-in Visual Basic script

- Nanosurf Analysis or Nanosurf Report: Complete data analysis and reporting software
- easyScan 2 Scripting Interface: User-defined customisation and automation
- Signal Module A: More measurement control and modes, more data analysis possibilities
- Micrometer Translation Stage: Position your sample with micrometer precision



Nanosurf® easyScan 2 Technical Data

Electronics	
Electronics size / weight	470 x 120 x 80 mm / 2.4 kg
Power supply	90 - 240 V~/ 30 W 50/60 Hz
Computer interface	USB 2.0
Integrated USB hub	2 Ports USB 1.1 (100 mA max)
Measurement channels	16 bit A/D converters, up to seven signals depending on configuration
Scan generator	16 bit D/A converter for all axes
Scan speed	Up to 60ms/line at 128 datapoints/line
Scan drive signals	± 10 V, no high voltage!
Scan area and data points	Individual width/height, up to 2048 x 2048 points
Scan image rotation	0 - 360°
Sample tilt compensation	Hardware X/Y-slope compensation
Spectroscopy modes	Single point measurement or multiple measurements along vector
Spectroscopy measurement averaging	1 - 1024
Spectroscopy data points	Up to 2048

Adapters for former easyScan Scan Heads available

Scan Software	
Various charts of the scan data can be displayed simultaneously:	Line graph, Colour map, 3D view, ...
Customisable display and parameter settings using user profiles	
On-line processing functions	Mean fit, polynomial fit, derived data, ...
Quick evaluation functions	Distance, angle, cross section, roughness, ...
Data export	BMP, ASCII, CSV, ...
Automatic image transfer to offline post processing software Nanosurf Analysis or Nanosurf Report	

Computer requirements (Computer not included with system)	
Operating system	Windows 2000, XP or newer
Electronics interface	USB port
Recommended PC hardware	Pentium 4/M or AMD Athlon, 256MB RAM, True colour 1024x786 video card, HW Open GL accelerator

Nanosurf easyScan 2 Scripting Interface	
Applications	Automating measurement tasks, lithography, custom evaluation functions, using third party measurement equipment, ...
Included control software	Windows Scripting Host: Visual Basic Script, Java Script, ...
Remote control by	COM compatible languages: LabView, MathLab, Visual Basic, Delphi, C++, ...

Nanosurf easyScan 2 Signal Module: S	
Available output signals	X-Axis, Y-Axis, Z-Axis, Approach, Tip Voltage, STM Current or AFM Deflection, Excitation, Amplitude, Phase
Full scale corresponds to	± 10 V, Excitation: ± 5 V
Power supply output	GND, + 15 V, - 15 V

Nanosurf easyScan 2 Signal Module: A	
All output signals of Signal Module: S	
Additional signal modulation inputs	X-Axis, Y-Axis, Z-Axis, Tip Voltage, Excitation
Free connectors	2 x Aux, connection made on user request
Modulation range	± 10 V, Excitation: ± 5 V
Additional analog user inputs	2 x 16 bit A/D converters, ± 10 V
Additional analog user outputs	2 x 16 bit D/A converters, ± 10 V
Synchronisation output	1 x TTL: start, end, point sync
Additional modes	Almost unlimited

User inputs can optionally be measured in all Imaging and Spectroscopy modes
 User outputs can be modulated in Spectroscopy measurements

Nanosurf® easyScan 2 Technical Data

STM measurement				
STM Scan Head:	500nm	1µm	500nm LC (low current)	1µm LC (low current)
Maximum Scan range 1)	500 nm	1.0 µm	500 nm	1.0 µm
Maximum Z-range 1)	200 nm	200 nm	200 nm	200 nm
Drive resolution Z 2)	3 pm	3 pm	3 pm	3 pm
Drive resolution XY 2)	7.6 pm	15 pm	7.6 pm	15 pm
Current set point	0.1-100 nA in 25 pA steps		0.02 - 20 nA in 5 pA steps	
Imaging modes	Constant Current (Topography), Constant Height (Current)		Sample approach	Stick-slip motor
Spectroscopy modes	Current-Voltage, Current-Distance		Sample size	Max. 10 mm diameter
Tip voltage	± 10 V in 5 mV steps			

1) These are typical values

2) Calculated by dividing the maximum range by 16 bits; atomic resolution on HOPG can be obtained with all STMs

AFM measurement			
AFM Scan Head:	10µm	70µm	110µm
Maximum Scan range 1)	10 µm	70 µm	110 µm
Maximum Z-range	2 µm	14 µm	22 µm
Drive resolution Z 2)	0.027 nm	0.21 nm	0.34 nm
Drive resolution XY 2)	0.15 nm	1.1 nm	1.7 nm
XY-Linearity Mean Error	< 0.6 %	< 1.2 %	< 0.6 %
Z measurement noise level (RMS,Static Mode)	0.07 nm (max. 0.2 nm)	0.6 nm (max. 0.8 nm)	0.4 nm (max. 0.55 nm)
Z measurement noise level (RMS,Dynamic Mode)	0.04 nm (max. 0.07 nm)	0.5 nm (max. 0.8 nm)	0.3 nm (max. 0.55 nm)
Design	Tripod stand-alone		
Sample size	Unlimited		
Automatic approach	5 mm		
Max. approach speed	0.1 mm/s		
Cantilever alignment	Automatic adjustment		
Electrical connection to tip	Available		
Scan head weight	350 g		
Sample observation optics	Dual lens system (top/side view)		
Optical magnification	Top 12 x / side 10 x		
View field	Top 4 x 4 mm / side 5 x 3 mm		
Sample illumination	White LEDs (brightness 0 - 100 %); axial illumination for top view		

1) Manufacturing tolerances are ± 15 % for 10 µm and 70 µm scan heads, ± 10 % for 110µm scan heads

2) Calculated by dividing the maximum range by 16 bits

Video Module	
Camera system	Dual video (top/side view)
Magnification	Top 100 x / side 70 x
View field	Top 3.2 x 2.7 mm / side 4.1 x 3.4 mm
Image pixels	352 x 288
Video display	In control software, can be saved as JPEG
Analog video output	PAL Video-S
Micrometer Translation Stage	
XY resolution	< 0.5 µm
Travel	13 mm

AFM Basic Module	
Imaging modes	Static Force (Contact) Const. Force (Topography), Const. Height (Deflection)
Spectroscopy modes	Force-Distance, Force-Tip voltage
Tip voltage	± 10 V in 5 mV steps
The AFM Basic Module is required for using AFM Scan Heads	
AFM Dynamic Module	
Additional imaging modes	Dynamic Force (Intermittent Contact, etc.) Const. Amplitude (Topography), Const. Height (Amplitude)
Additional spectroscopy modes	Amplitude-Distance
Dynamic frequency range	15 - 300 kHz
Dynamic frequency resolution	< 0.1 Hz
The AFM Basic Module is required for using the AFM Dynamic Module	

AFM Mode Extension Module	
Additional imaging modes	Phase Contrast, Force Modulation, Spreading Resistance, Magnetic Force, Electrostatic Force
Additional spectroscopy modes	Phase-Distance, Current-Voltage, Current-Distance, etc.
Phase contrast range	± 90°
Phase contrast resolution	< 0.05°
Phase reference range	0 - 360°
Tip current measurement	± 100 µA, 3 nA resolution
Both the AFM Basic Module and the AFM Dynamic Module are required for using the AFM Mode Extension Module	

Compatible Cantilevers	NANOSENSORS® and NanoWorld®	Applied Nanostructures
Basic Module	CONTR, LFM, ZEILR	SICONA
Dynamic Module	NCLR, XYNCHR	ACLA
Mode Extension Module	MFMR, CONTPt, NCLPt, CDT-NCLR	MAGT, FORTA, ANSCM-PC, ANSCM-PT
Available tips	Standard, SuperSharp Silicon, HighAspectRatio, Diamond	Rotated pyramidal (standard)



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